Microstructures within glaciogenic Neoproterozoic Diamictites around the Congo River Basin (CRB) in Democratic Republic of Congo - a comparative micromorphological study.

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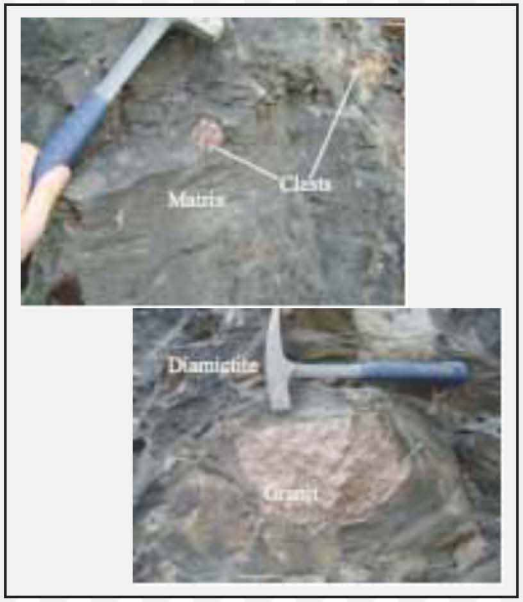
Introduction

What is a diamictite?

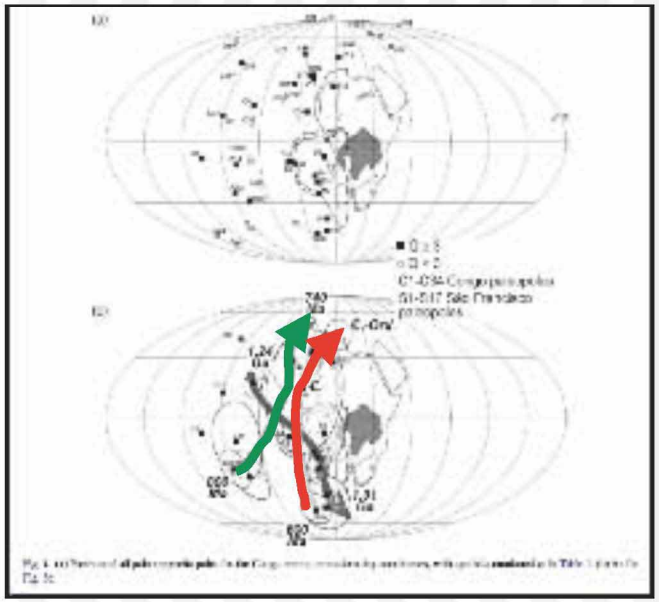
A diamictite is a poorly or non-sorted conglomerate with a wide range of clasts, up to 25% of them gravel-sized (greater than 2 mm). Diamictites are composed of coarse, angular to well rounded sedimentary clastic fragments including fragments of igneous and metamorphic rocks, supported by a typically argillaceous matrix.



Port Askaig Diamictites, Port Askaig Scotland (Delpomdor, 2009)

Why study the diamictite?

- characterize the diamictite deposits (macro- and microstructures) and define their origin (glaciogenic or non-glaciogenic rocks);
- explain the co-existence of Diamictite and Cap Carbonate (couple diamictites/cap carbonate, 'triade', ...);
- interpretate the environment in a model paleaogeographic (paleao-magnetism, etc.);
- economic importance (mining, oil reservoir).



Tohver et al. (2006)

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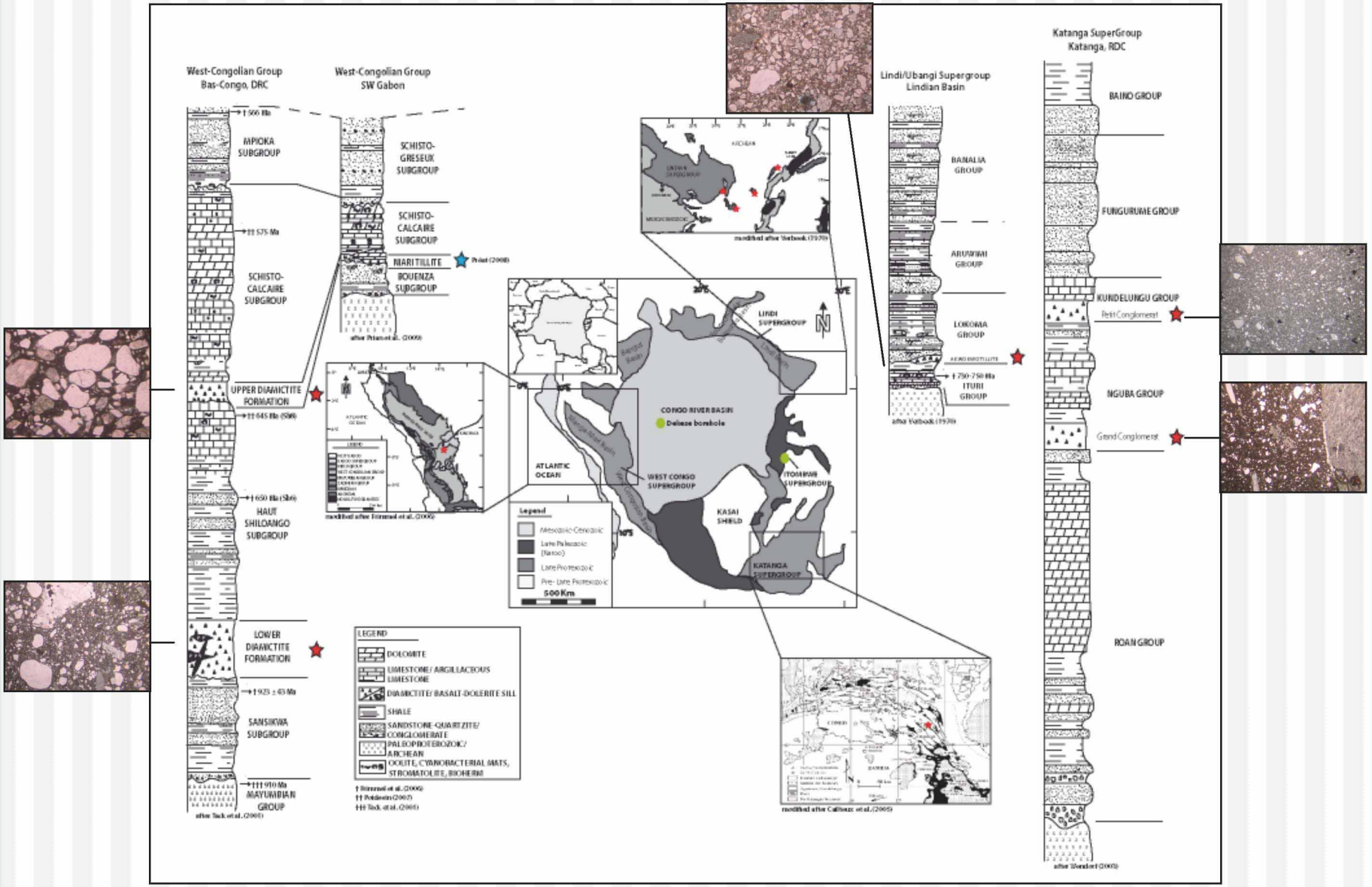
The Diamictites in Democratic Republic of Congo



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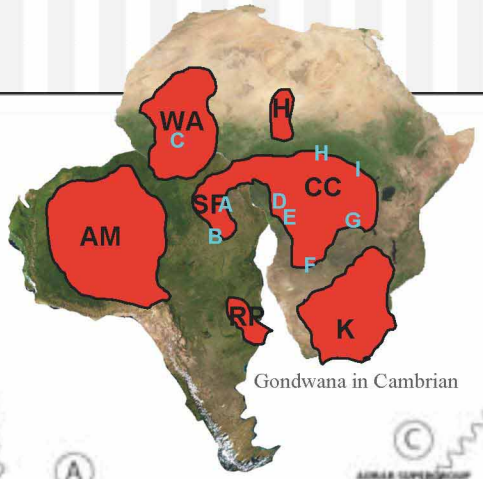
Ages



Gondwana in Cambrian

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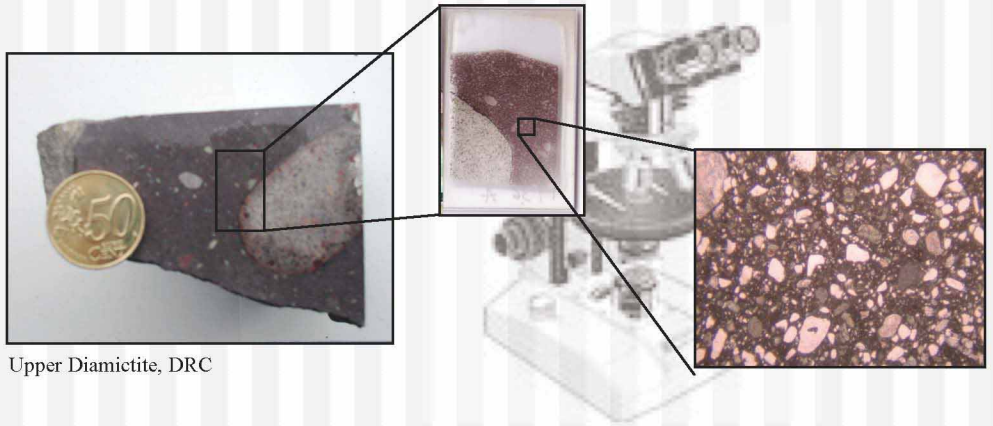
Samples

- Samples collected in the Royal Museum of Central Africa, Tervuren-Belgium (250,000 samples collected in Central Africa);
- Thin sections (more 30 samples) for micromorphology analysis;
- Characterization of Neoproterozic diamictites and comparison with the Carboniferous Tillite of the Lukuga Formation.



Upper Diamictite, DRC

Methodology

1.CHARACTERIZATION OF THE THIN SECTION

- Sample identification (location, sample lithofacies, etc.)
- Macroscopic description sample

2. TEXTURAL ANALYSIS

SKELETON

- Size ranges
- Particle shape and form
- Distribution
- Composition

PLASMA/MATRIX

- Texture
- Density
- Distribution

3. STRUCTURAL ANALYSIS

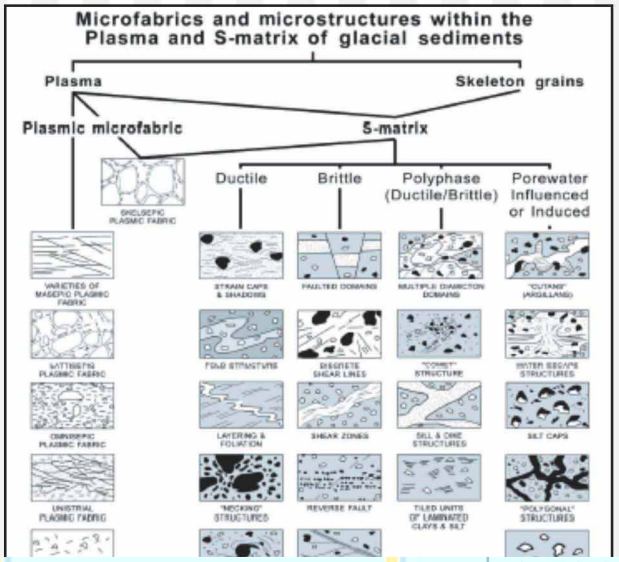
- Vood ration, type and distribution

MACROFABRIC

- Horizontal/vertical

STRUCTURES

- Sedimentary structures
- Deformation structures
- Diagnostic features for specific environments
- Diagenesis and post-depositional alteration



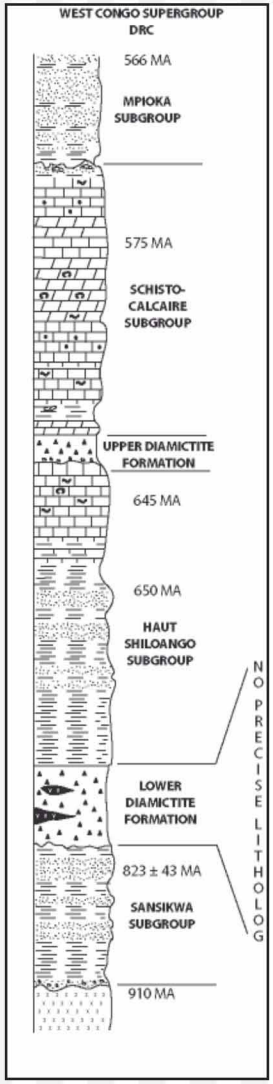
s of glacigenic sediments adapted after van der Meer (1993; 1996) and

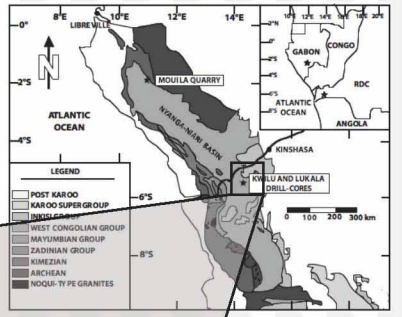
Modified by Menzies (2000) after van der Meer (1993)

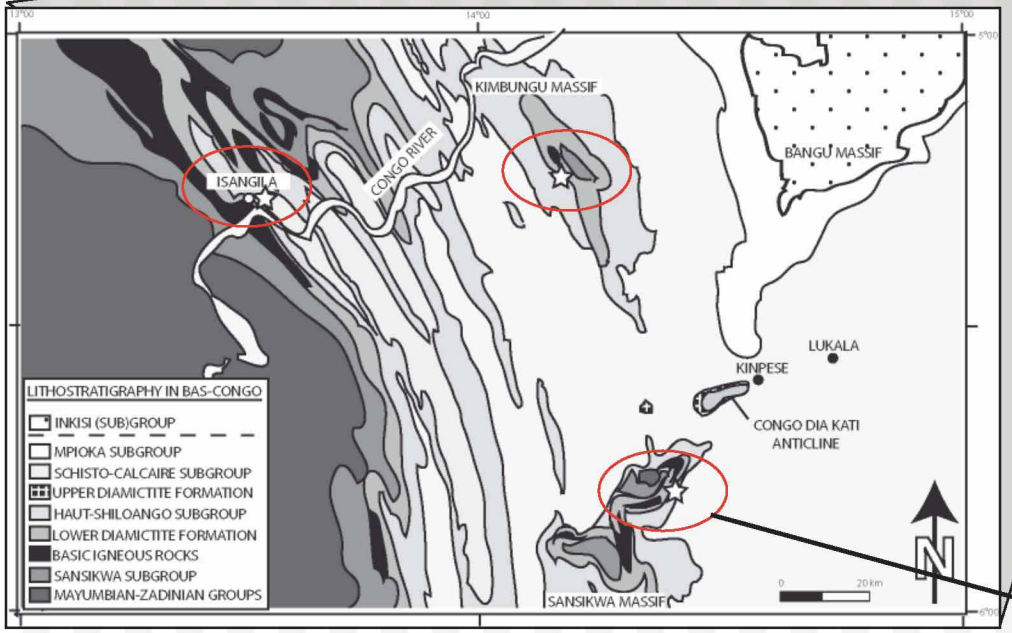
Suggested approach for describing thin section Carr (1999). Evans and Benn, 2004)

Micromorphology

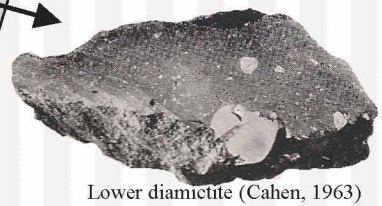
Lower Diamictites



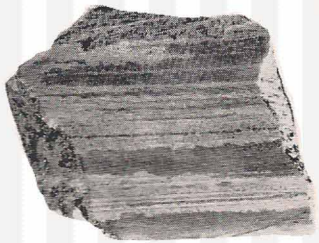




Polished sufaces on pebble (Cahen, 1963)



Lower diamictite (Cahen, 1963)



Zoned argillaceous rock -varvite- (Cahen, 1963)

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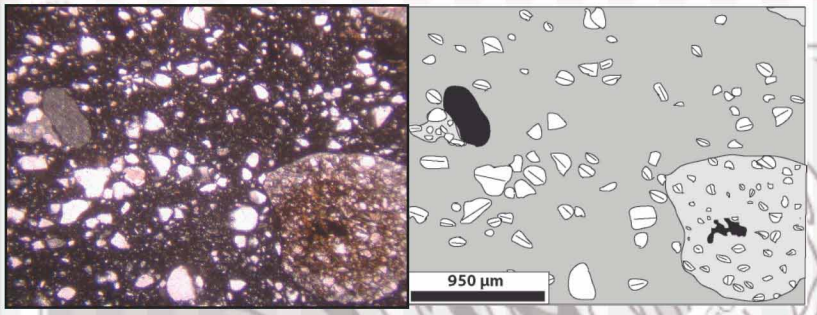
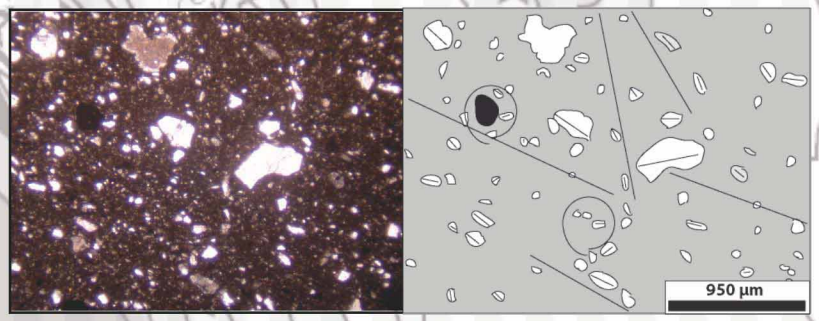
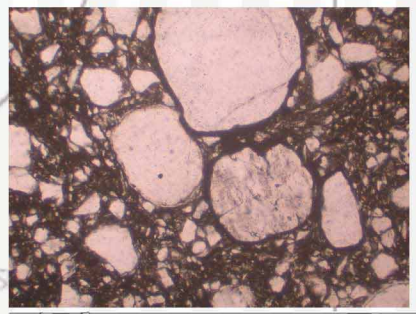
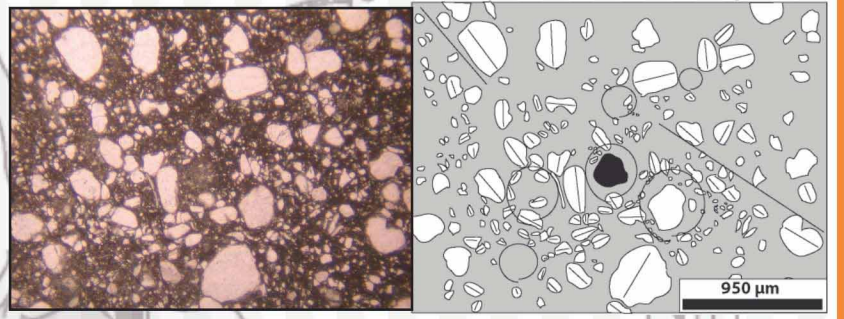


In Isangila:
- masepic to lattisepic plasmic fabrics;
- numerous discrete lineations and pressure shadows;
- pebbles type III and 'till' pebbles.

In the Kimbungu massif:
- lattisepic plasmic fabrics;
- discrete shears lines;
- rotational structures;
- pebbles type III.







LITHOSTRATIGRAPHY IN BAS-CONGO

	Skeleton				Plasma				
	Grain size	Sorting	rounded	Angular	Skelsepic	Lattisepic	Omnisepic	Insepic	Masepic
Sansikwa massif	20 to 500 µm	poorly	-	+	+	++	/	/	/
Kimbungu massif	20 to 500 µm	poorly	-	+	+	++	/	/	/
Isangila	50 to 500 µm	poorly	-	+	+	++	/	/	/

Matrix		Deformation							
Grains	Clays	Rotate/turbate	Grain to grain contact	Imbricated grains	Stacked grains	Clay balls	Lineations	Shears	Others
+	++	++	-/+	-	+	+	-/+	-	
+	++	+	-/+	-	+	+	+	-/+	
+	++	-/+	-	-	++	+	++	+	

In the Sansikwa massif:
- lattisepic to skelsepic plasmic fabrics;
- some discrete lineations;
- abundant rotational structures;
- pebbles type III.

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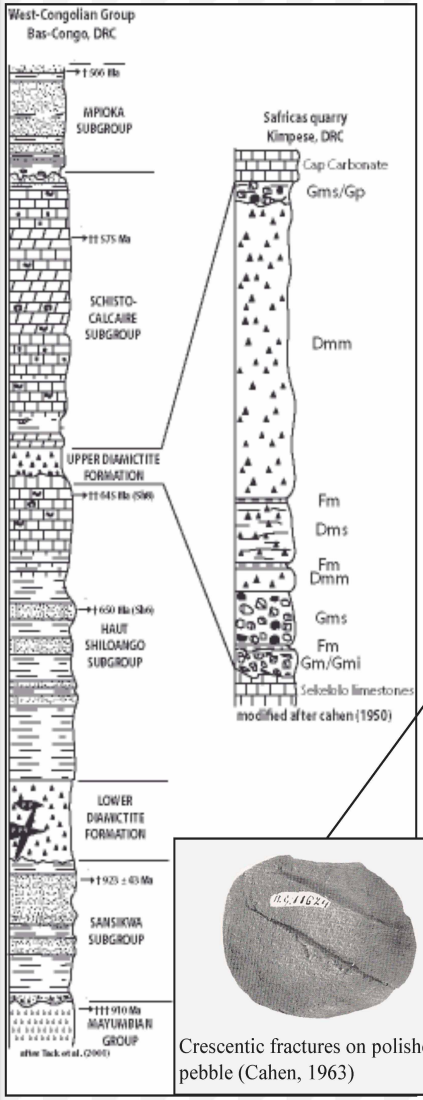
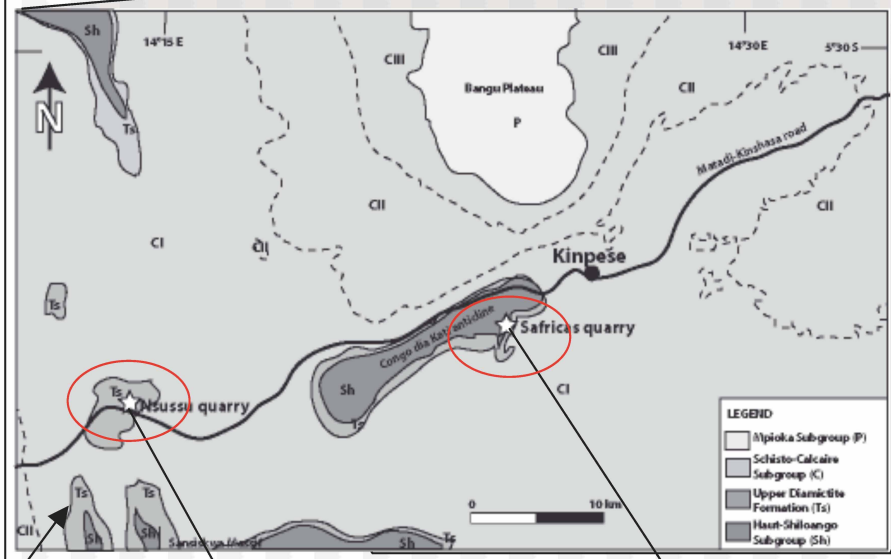
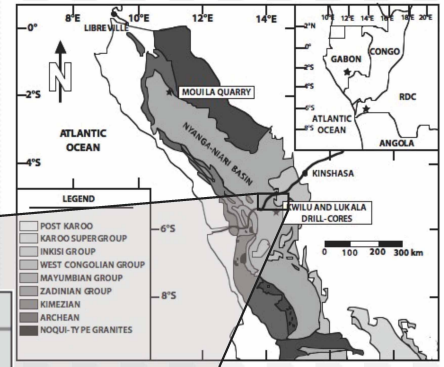
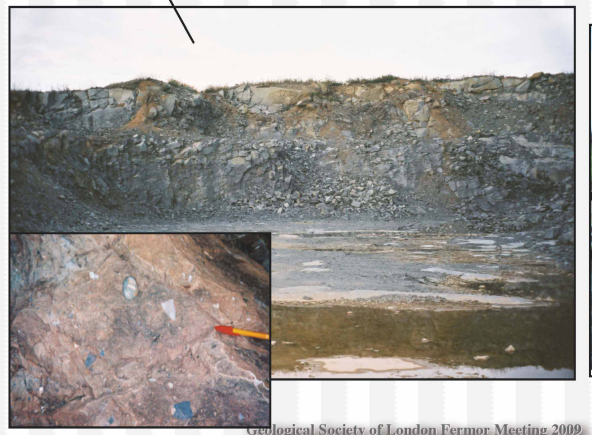
Upper Diamictites (Nsussu and Safricas quarries)







Crescentic fractures on polished pebble (Cahen, 1963)



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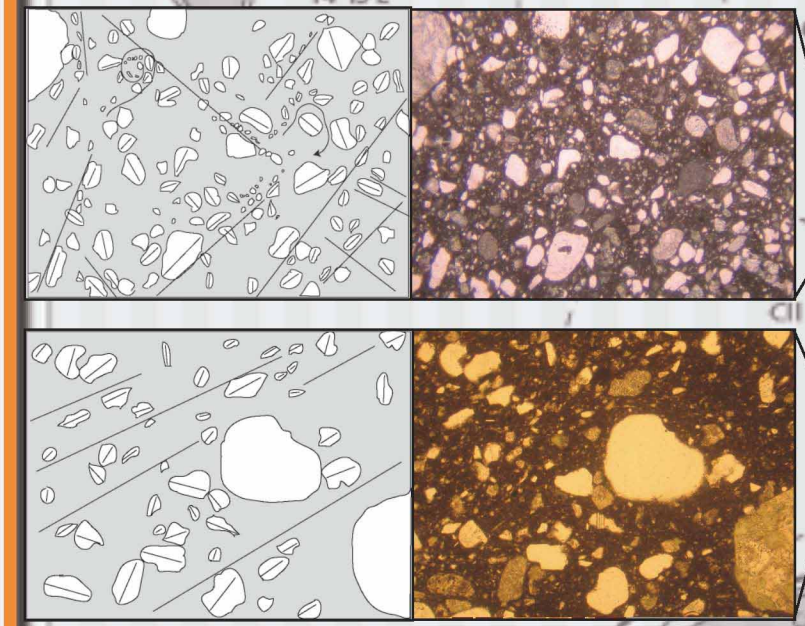
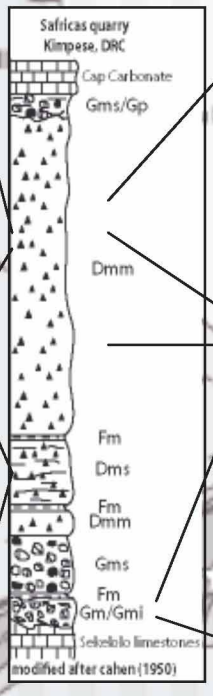
Nsussu quarry

Safricas quarry





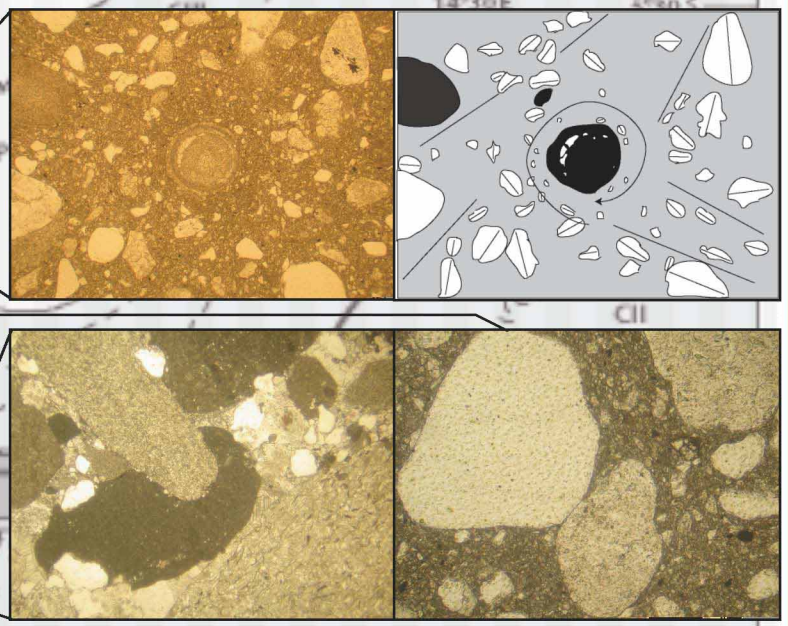


Table 1 : Tableau général de la description morphologique de la Diamictite supérieure du Bas-Congo (République Démocratique du Congo)

Lame mince	Squelette				Plasma				
	Taille des grains dominants (µm)	Granulo-classement	Arrondi	Angularité	Skelsepic	Lattisepic	Omnisepic	Insepic	Masepic
1736 A	200	chaotique	-	++	/	+	+	/	/
18049	500	chaotique	++	-	++	+	/	/	/
1727	200	chaotique	++	+	/	/	+	-	/
1736 B	200	chaotique	++	+	/	+	+	/	/

Matrice		Déformation							
Grains	Mudstone	Rotation	Contact grains à grains	Grains imbriqués	Structure en col	Rolling-ball	Galets argileux	Linéations	Structure empilée
-	++	+	-	-	-	-	++	++	+
+	++	++	++	++	++	++	++	++	+
-	++	+	+	-	+	+	+	+	+
-	++	+	-	-	+	+	+	(?)	+

Notations: -, rarement développé; +, commun à moyennement développé; ++, fortement développé.

In the Nsussu quarry:
- lattisepic plasmic fabrics;
- abundant discrete shears lines;
- rare rotational structures;
- pebbles type III.

In the Safricas quarry:
- lattisepic to skelsepic plasmic fabrics;
- some discrete shears lines;
- abundant rotational structures;
- pebbles type III.

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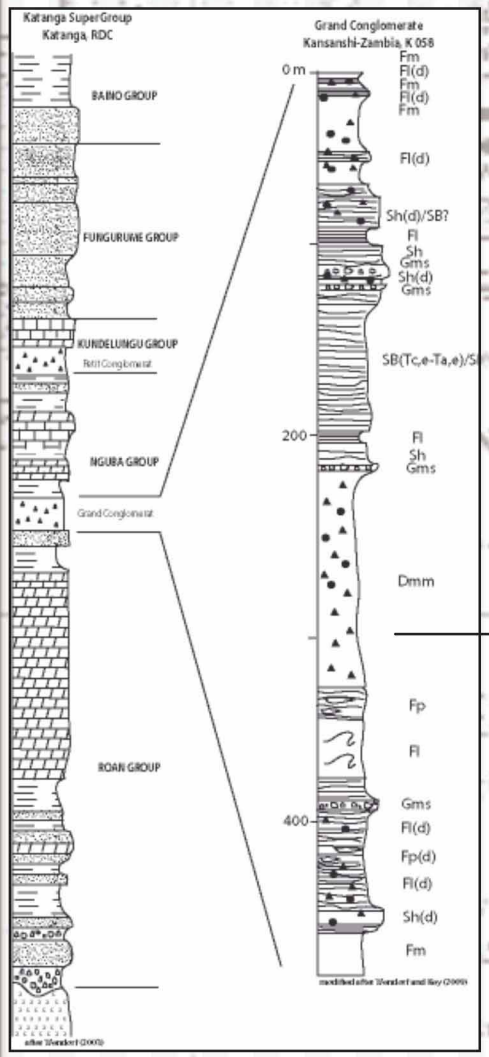
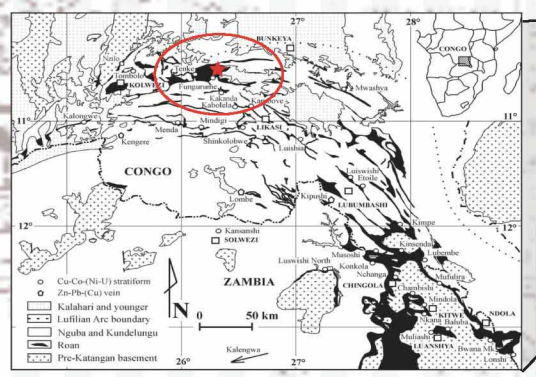
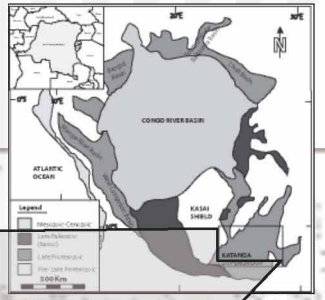
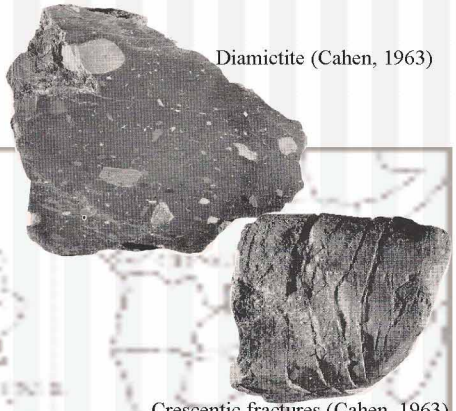
Grand Conglomerate



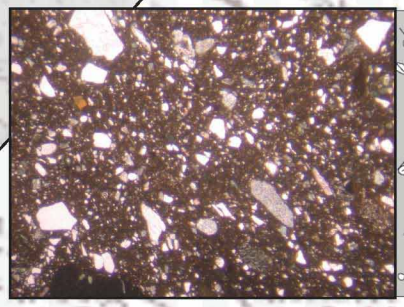


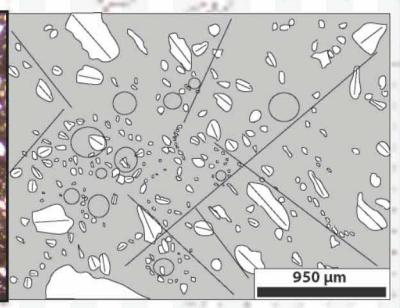


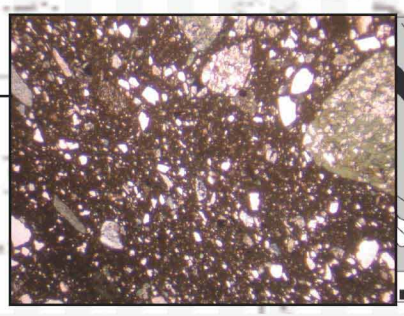


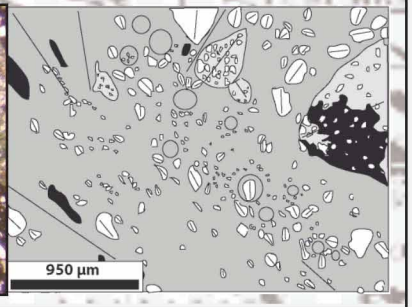
Diamictite (Cahen, 1963)

Crescentic fractures (Cahen, 1963)









- masepic-lattisepic plasmic fabrics;
- abundant discrete shears lines and pressure shadows;
- rotational structures;
- clay coating;
- silt caps by clays
- pebbles type III.

	Skeleton				Plasma				
	Grain size	Sorting	rounded	Angular	Skelsepic	Lattisepic	Omnisepic	Insepic	Masepic
Diamictite in Mokabe Kasari	20 µm to 2,5 mm	poorly	-	+	/	+	/	/	+

Matrix		Deformation							
Grains	Clays	Rotate/turbate	Grain to grain contact	Imbricated grains	Stacked grains	Clay balls	Lineations	Shears	Others
+/-	+	+/-	-	-	++	-/+	++	-	Silt caps, clay coating, injection structures

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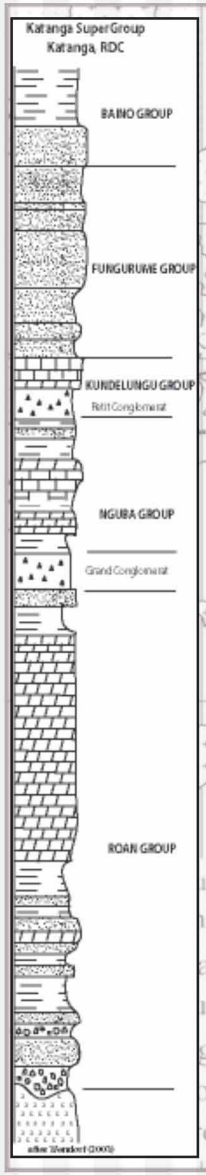
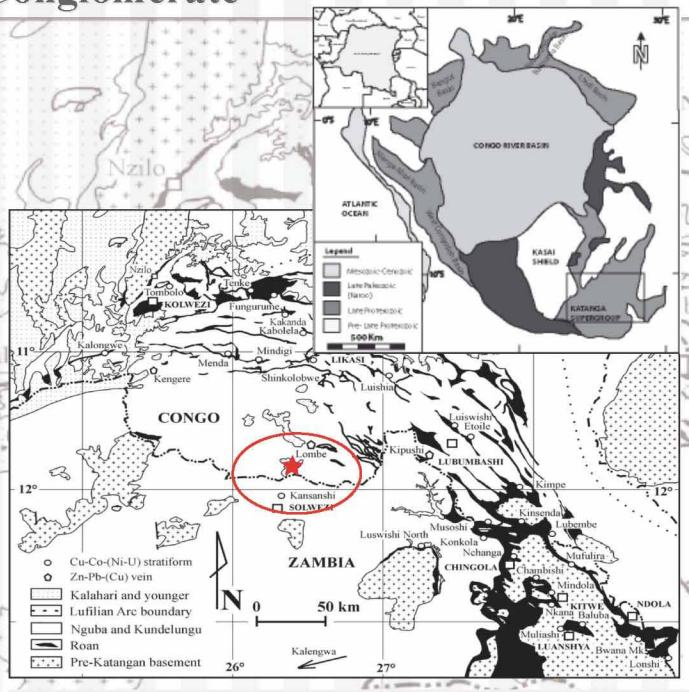
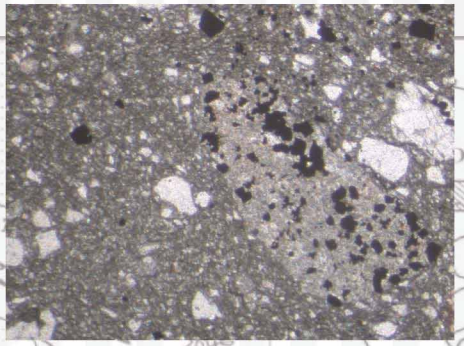
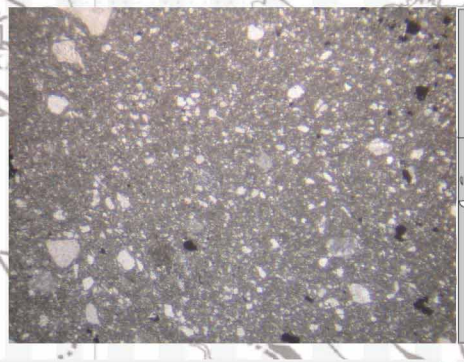
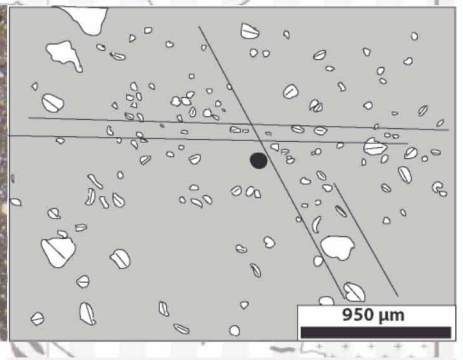
Petit Conglomerate







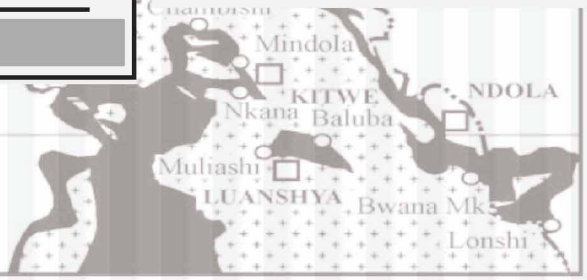




	Skeleton				Plasma				
	Grain size	Sorting	rounded	Angular	Skelsepic	Lattisepic	Omnisepic	Insepic	Masepic
	20 µm to 1 mm	poorly	-	+	+	+	/	/	/

Matrix		Deformation							
Grains	Clays	Rotate/turbate	Grain to grain contact	Imbricated grains	Stacked grains	Clay balls	Lineations	Shears	Others
+/-	+	+/-	-	-	++	-/+	++	-	

- lattisepic plasmic fabrics;
- abundant discrete lineations;
- pressure shadows;
- pebbles type III.



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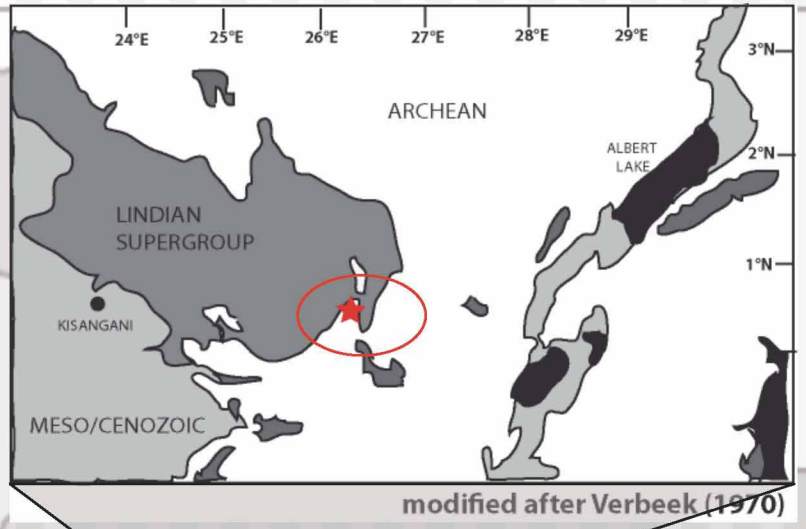
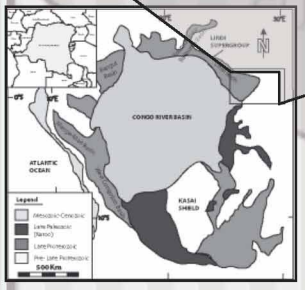
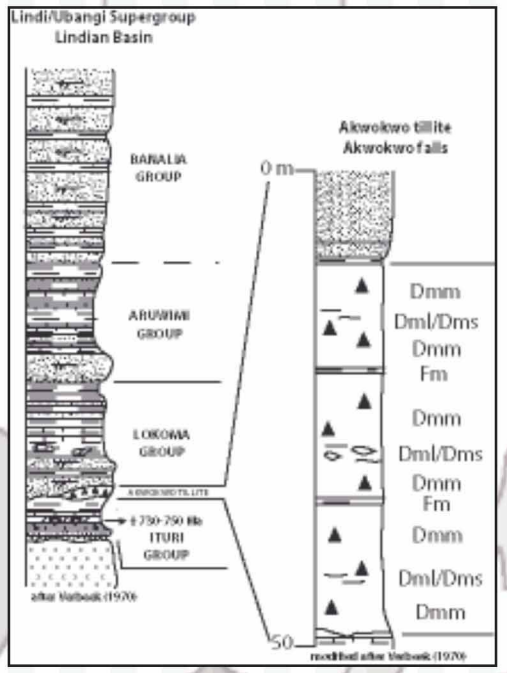
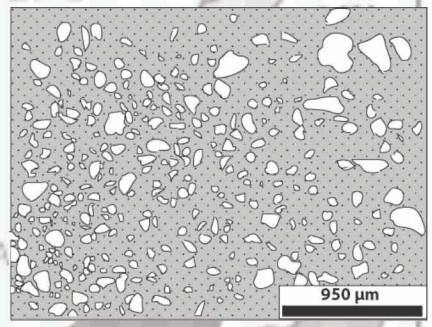
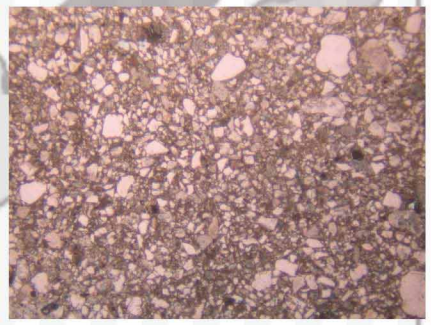
Akwokwo Diamictites











- skel- to latti-sepic plasmic fabrics;
- rare discrete shears lines;
- rare rotational structures.

Skeleton					Plasma				
Grain size	Sorting	rounded	Angular		Skelsepic	Lattisepic	Omnisepic	Insepic	Masepic
20 µm to 1 mm	poorly	-	+		++	++	/	/	/

Matrix		Deformation							
Grains	Clays	Rotate/turbate	Grain to grain contact	Imbricated grains	Stacked grains	Clay balls	Lineations	Shears	Others
++	+	-	+	-	++	-/+	++	-	

ULB University of Brussels Department of Earth Sciences and Environment

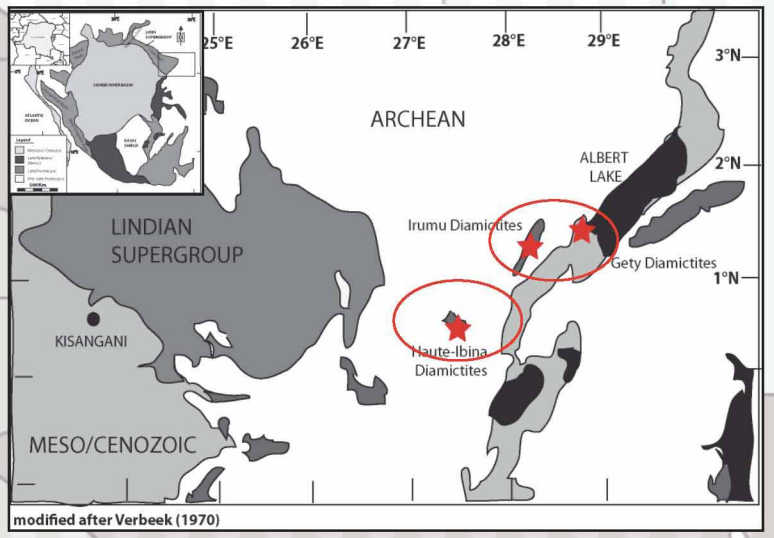
Africa Museum TERVUREN Royal Museum of Central Africa Teruren, Belgium

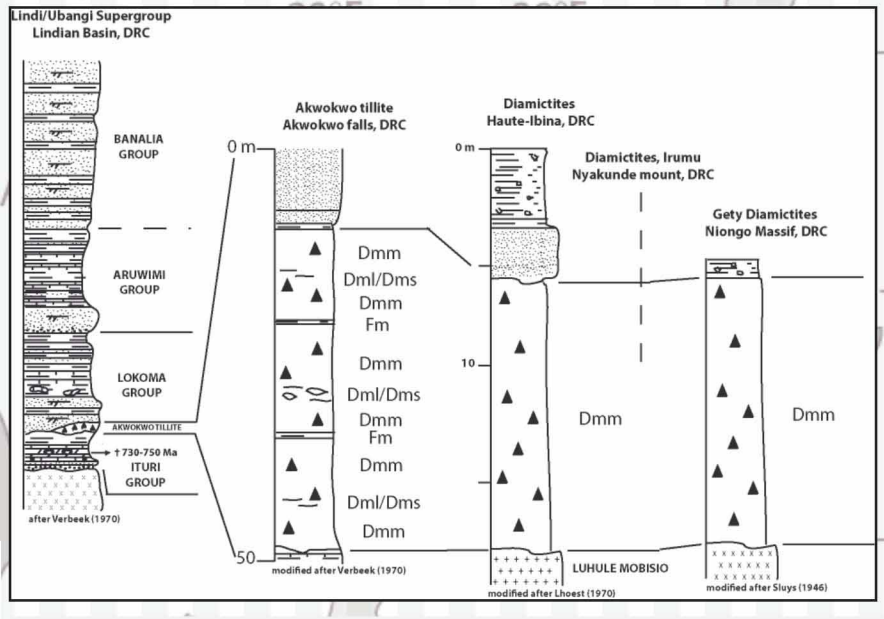
Geological Society of London Fermor Meeting 2009
Supercontinents, Superplumes and Scotland
6-13 September 2009, Edimburgh, UK

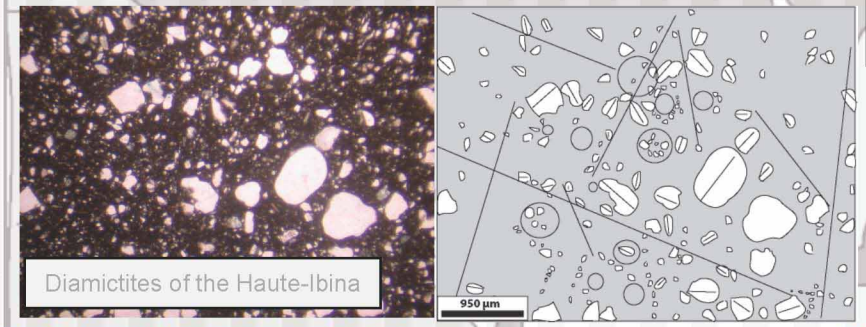
Delpomdor et al. 2009

Some others curiosities

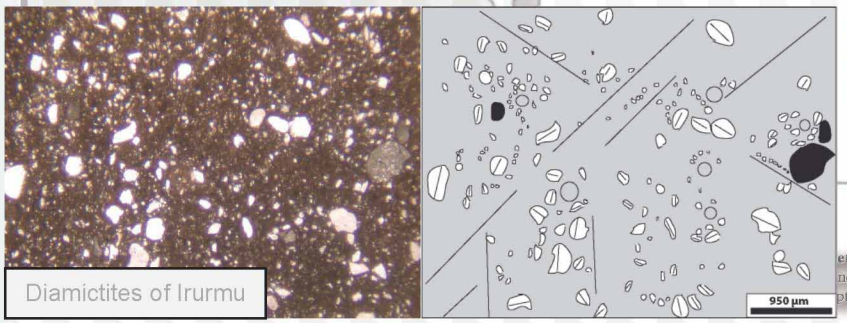
Isolated Diamictites correlated with the Lindian Akwokwo Tillites

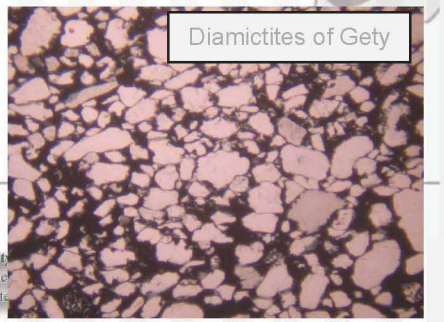






In the Haute-Ibina:
- masesepic plasmic fabrics;
- discrete shears lines associated with pressure shadows;
- rotational structures.





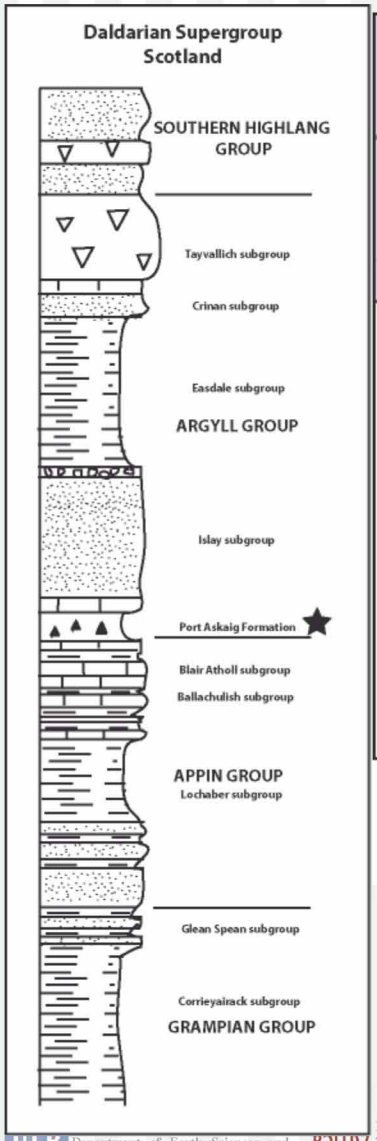
In Irumu:
- masesepic plasmic fabrics;
- discrete shears lines.

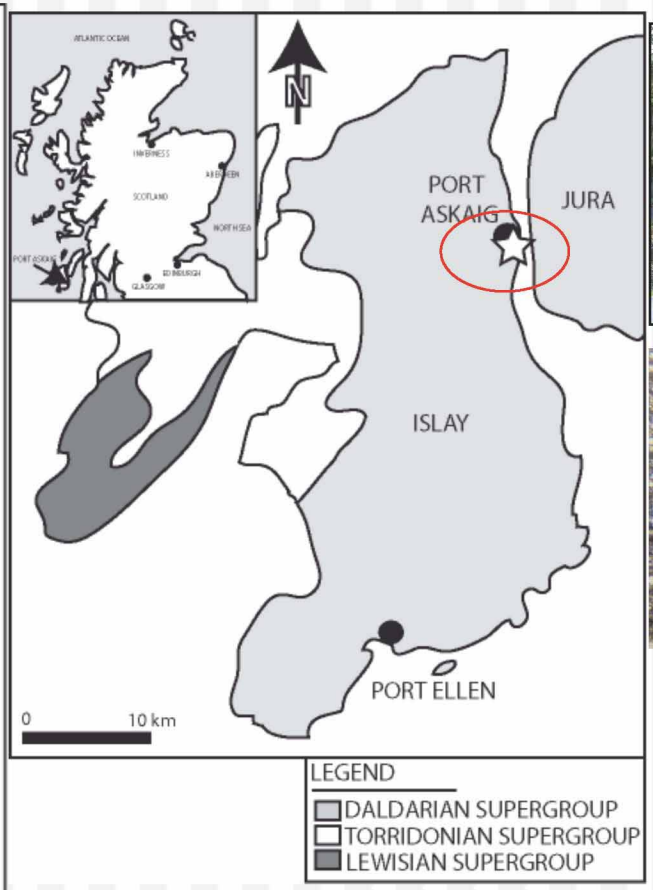
In Gety:
- Skelsepic fabrics;
- necking structures;
- silt caps by clay coating.

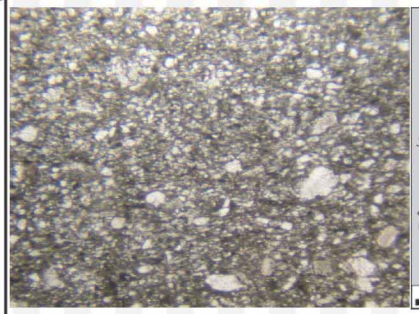
Delpomdor et al. 2009

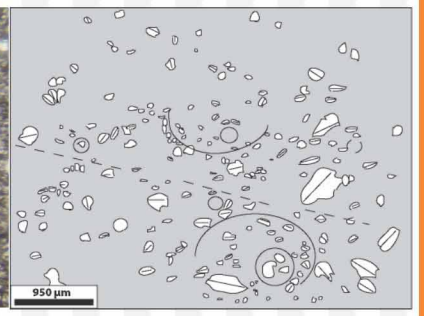
Comparison (1)

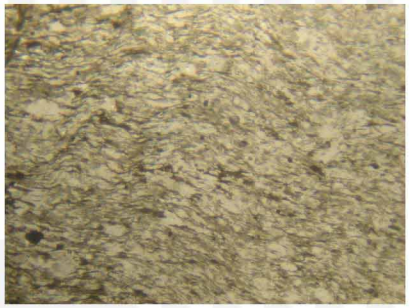
Diamictites of the Port Askaig (Port Askaig, Scotland)







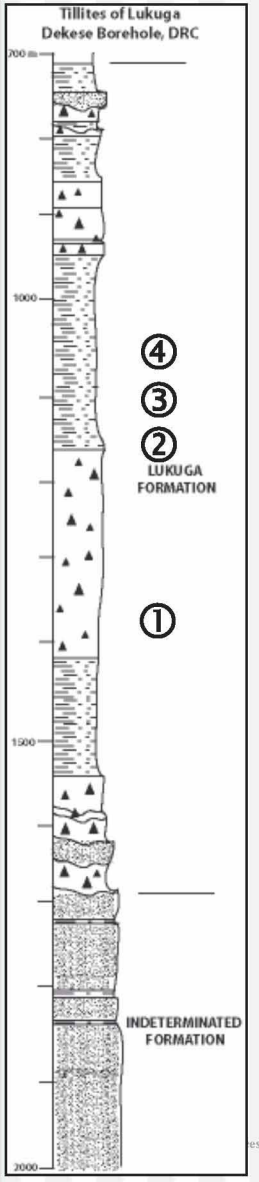


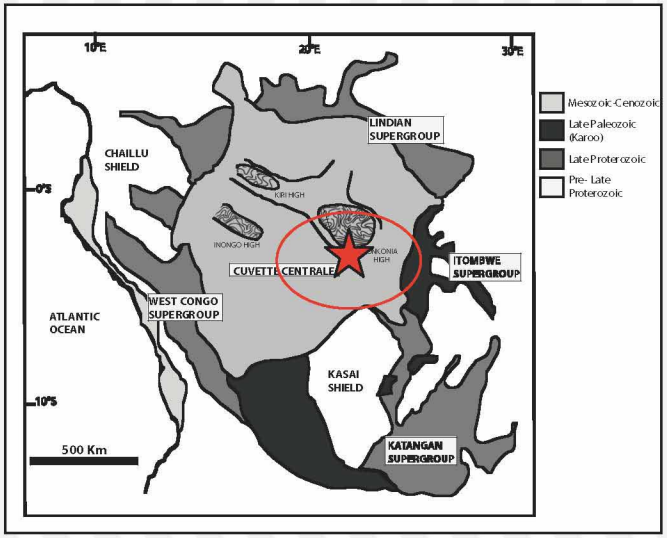


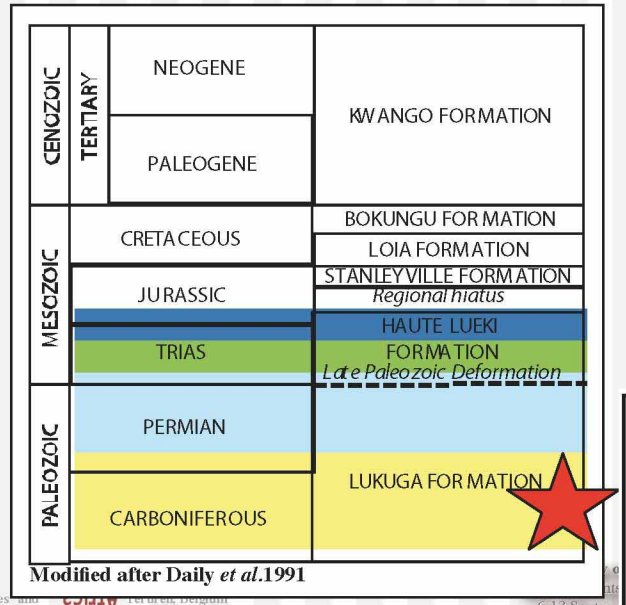
- secondary foliation and crenulation microstructures;
- omnisepic plasmic fabrics;
- rare rotational structures;
- pebbles type III.

Comparison (2)

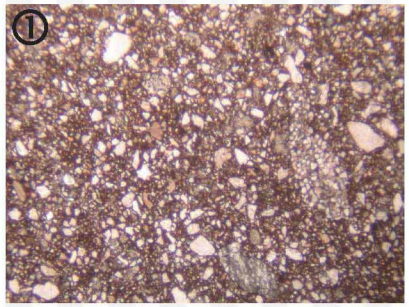
Carbonifereous Tillites of the Lukuga Formation (Dekese borehole, RDC)

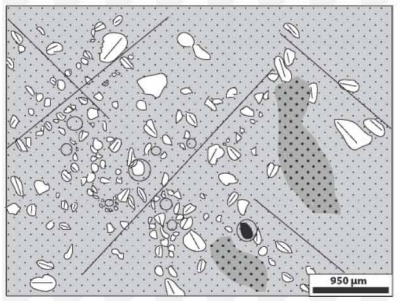


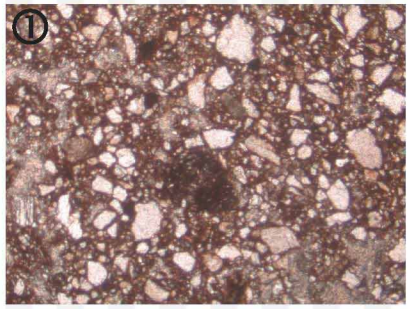


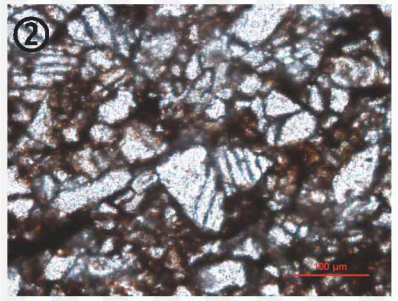


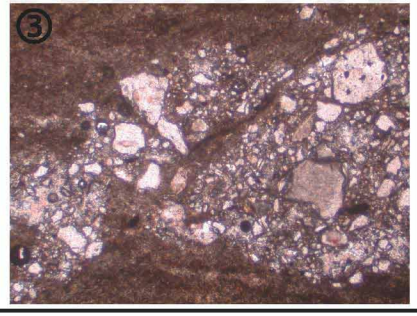
Modified after Daily *et al.*1991

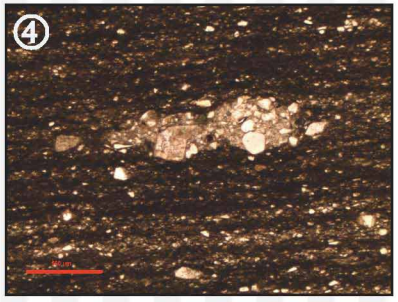












	Skeleton				Plasma				
	Grain size	Sorting	rounded	Angular	Skelsepic	Lattisepic	Omnisepic	Insepic	Masepic
Lukuga tillite	20 to 500 µm	poorly	-	+	++	++	/	/	/

Matrix		Deformation						
Grains	Clays	Rotate/turbate	Grain to grain contact	Imbricated grains	Stacked grains	Clay balls	Lineations	Shears	Others
++	+	++	+	-	++	-/+	++	-	

Conclusion

The microstructures indicate:

- **The Lower diamictite represents a passage, from east to west, of probable proximal subglacial or subaqueous to proximal glacimarine deposits including debris flow deposition or submarine mass-movements.**
- **The Upper Diamictite characterizes alternations of subglacial and/or fluvio-glacial deposition.**
- **In Katanga, the Grand Conglomérat is subjected to pore water influences suggesting a proximal to distal glacimarine deposition or glaciomarine mass-movement.**
- **The Petit Conglomérat is similar to the Upper Diamictite Formation in Bas-Congo**
- **The Lindian diamictites show a probable true glacial and subglacial deposits like Akwokwo tillites evolving at the west in clay-rich diamictites resulting from remobilization of glacial sediments with debris-flow and/or turbidites (diamictite from Gety)**
- **The Tshibangu Formation (in Itombwe syncline) presents a diamictite-like conglomerate. The micromorpholgy is similar to the others observed diamictites.**
- **In comparison of Carboniferous tillites of the Lukuga Formation in the center of the DRC presenting massive tillites, laminated tillites resulting from laminar water flow and argillites, the structures and the plasmic fabrics of the Neoproterozoic diamictites are strongly similar indicating glaciogenic depositions in proximal to distal glacial environment.**